# MULTIFUNCTIONAL SWITCH DEVICE

The present invention relates to a tilting device and a tilt function for multifunctional switches, especially developed for use in electronic equipment and in handheld apparatus and for vehicles and means of transport.

Handheld electronic equipment is constantly being endowed with more functions and areas of application. In vehicles, new functions that are to be operated by the driver are constantly being introduced. It has been found that the conventional keypads are not particularly user friendly in connection with small apparatus and for use in conjunction with driving a car or similar situations.

The Inventor has previously described several types of multifunctional switches which together with an adapted graphical user interface can replace or complement conventional keypads. In other words, it is intended that the switch should be able to function interactively with a menu system shown on a display screen, for example an LCD screen. However, one of the objects is that the information displayed on the screen should be easy for the user to understand, depending upon the physical design of the switch device. The Applicant's earlier applications which form the basis for the invention include the following: WO 0034965, WO 0141402, WO 0161637, PCT/NO02/00231 and PCT/NO02/00309.

The multifunctional switches previously described by the Inventor have a rotation and/or sliding function and at least three press or tilt functions. These are arranged in direct connection with the operating element of the switch and make the whole construction compact and versatile. The systems described exhibit different solutions for tilt or press functions. These solutions involve primarily the use of several parts which interact to create the press and tilt effect that is required.

The object of the present invention is to obtain a construction which uses fewer parts, has a long wear life and yields production and production-economic advantages.

The invention relates in particular to an embodiment of a tilt function for a switch having four tilt or press functions and a centre press. The embodiment will therefore be suitable for use in switches having rotation or sliding functions. However, other types of multifunctional switches are also conceivable.

The characteristic features of the invention are set forth in attached independent claims 1 and 8 and the respective dependent patent claims associated therewith, and in following description with reference to the attached drawings.

The following figures will describe the invention and in particular in connection with a rotatable multifunctional switch. However, the solution or technology illustrated and described herein is easily transferable to many of the multifunctional switches described in, *inter alia*, in the Inventor's previously mentioned applications, in order to simplify and improve these earlier solutions.

Any person skilled in the art will see that the solutions can be used in switches and operating controls in connection with many forms of electronic equipment.

Figs. 1a-b are views of a tilting part.

Figs. 2a-2d show the tilting part in a multifunctional switch with rotation.

Figs. 3a-3d show a variant of the rotary multifunctional switch equipped with the tilting part.

Fig. 4 shows the function of the operating element.

Fig. 5 shows the individual parts of which the switch is comprised.

Figs. 6a-6b show the switch when assembled, without the operating element.

Figs. 7a-7e show the switch when assembled, with the operating element, and sections thereof.

Figs. 8a-d show a typical design of the touch part of the operating element.

Fig. 9 shows a variant of the switch in Fig. 5.

The invention will now be described in more detail with reference to the figures and also in conjunction with the attached patent claims.

The multifunctional switches with tilt functions that are described in the Applicant's earlier applications are largely based on interaction between several movable parts. The present invention teaches a multifunctional switch which obtains a tilt and press function by using a flexible tilting device which may be termed a cardan unit. The cardan unit 1 employs a principle known from a cardan or a flexible rod. As shown in Fig. 1, the cardan unit 1 consists of various "parts". However, these are fixedly connected to each other. This means that in production the cardan unit 1 can be moulded as a single part. The cardan unit 1 consists of an outer ring 2 which is fixedly attached via two "shafts" 4 and 4' to frame part 6. In this case, the frame part 6 is a housing for the switch which provides the basis for the description of the invention in this application. A cross member 8 is fixed to the ring 2 via two "shafts" 7 and 7'. The cross member has four projections 9-9''' about an annular centre part. The shafts 4-4' and 7-7' are non-rotatable, but are fixedly connected at both ends. Thus, this is a modified cardan coupling because in general a cardan coupling has rotatable bearings, whilst this solution employs self-returning cardan elements 2 and 8 due to torsional forces which return the elements to a neutral position. The whole cardan unit 1 could be made of a flexible material, for example, of various types of plastic or types of hard rubber. The shafts will nevertheless be of such shape and thickness that the material here will yield to applied force and cause torsion which will actuate an underlying contact point as indicated by 14'-14''''.

The cardan unit 1 can be moulded in one piece independent of the frame, as indicated in Fig. 2b, or as a piece of the frame as shown in Figure 3.

It should also be pointed out here that the cardan unit may be in two parts, where the ring 2 is movable relative to the cross member 8 in a known way in that the shafts are rotatable about centre lines 11-11'. However, this would be a more conventional method which would not obtain the advantages that a one-piece, flexible solution would.

The following description will show a complete solution for a rotatable multifunctional switch with a central press function and four tilt functions.

Fig. 2a shows a frame 12 which has in the bottom spring-loaded contact points 14-14''''.

Fig. 2b shows a fitted tilting part 1 as described in connection with Fig. 1. The reference numerals 16-16' indicate contact points for detection of the rotation function.

Fig. 2c shows two contact springs 18 and 18' which act against the contact points 14-14' when the centre part 20 is rotated, thereby registering the movement thereof.

Fig. 2d is a sectional view through the rotatable multifunctional switch. A touch element 22 is fastened to the centre part 20. The central contact point 14 will be actuated by pressing on the centre of the touch element, indicated by the arrow 24. Pressing in one of the four directions, indicated by the arrows 25-25" will bring about a tilting movement of the tilting device 1 which causes the associated projection of the cross member 8 in underlying position, as shown in Fig. 1a, to activate contact. A fourth action point is not visible in the figure, but can be seen more clearly in Fig. 4.

Fig. 3 shows a variant of the solution described above in connection with Fig. 2. The difference here is that contact points are located directly on a printed circuit board. A frame 30 will thus be capable of being mounted directly on the circuit board as shown in Fig. 3d. Fig. 3b shows clearly how the stepwise rotation is intended to be effected. In this figure two springs 32 and 32' are mounted, which springs rest against faces indicated by reference numeral 34. On rotation of the centre part 20, a stepwise movement will be obtained. Another aspect of the invention is that the cardan-like tilting device 1 can be made in a single piece with the frame part 8 in the embodiment shown in Fig. 3a. This may give production advantages, but may mean that the frame part and the tilting device are moulded in different materials.

Fig. 4 shows a rotatable, tiltable and depressible multifunctional switch 38. This solution is used as an example of the tilting device according to Figs. 2-3 and 5-9.

The following description and accompanying drawings show an alternative switch. Fig. 5 shows the individual parts of which the switch is comprised, whilst Fig. 6 is an enlarged illustration of the assembled switch without the upper operating member. A plate or base 50 has two rocker bearings 51-52 which form supporting points for a tilting device 53. The tilting device 53 is partly constructed like the solution shown in, for example, Fig. 1, and functions according to the principles illustrated and described therein, but unlike that solution, two shafts 55-56 that are fastened to an outer part 54 on each side of the tilting device 53 will provide a free, rotatable movement in the rocker bearing as opposed to the torsional effect provided by the previous solution. This results in a modified cardan coupling, as a cardan coupling generally has four rotatable bearings whilst the present cardan-like tilting device has two. The inner part of the

tilting device 57 is fastened to the outer part via two "shaft" parts 58-59 which are offset 90° relative to the shafts 55-56. In production it will be possible to mould the whole tilting device 53 in one piece. The material used is flexible, for example, a suitable type of plastic. The shaft parts 58-59 have a thickness and a shape which mean that the inner part 57 can turn relative to the outer part 54. The base 50 has a signal handling section 60 to which snap discs 61-65 are attached above contact fields 71-75 and which together form switch contacts. The inner part of the tilting device is cruciform with four projections 66-69 (see Figs. 6a-6b) arranged diagonally relative to the shafts and where the projections are arranged above the snap discs 62-65 (see Fig. 5). The switch has an operating member 80 which at the bottom of Fig. 5 is shown from the underside with associated parts. The operating member has a central shaft part 81 which passes through the tilting device. A spring 82 is secured in the operating member. The spring is in the form of a clip and grips about the centre portion 76 of the tilting device. This portion is circular and has a plurality of faces about which the spring grips. On rotation of the operating member, this will cause a stepwise movement. In this case, there are eight faces which provide corresponding steps, although this number should not be understood as limiting for the invention. A contact part in the form of a slip ring 84 is also fastened to the operating element. This ring has pins 85 and 86 that are in contact with a contact field 77 (see Fig. 6a) in a frame part 78. The contact field 77 is so divided that it registers rotation of the operating element through the slip ring. This is done in a way that will be familiar to the skilled person and is not described in more detail here. The frame part 78 rests directly on the base part 50 of the switch and, as shown in Fig. 5, it can be fastened by using catches 90. The frame part is in contact with the signal handling section 60 for transmission of signals to and from the contact field 77 and the slip ring 84. Figs. 6a-b show clearly the diagonal position of the projections of the tilting device with associated snap discs and contact fields in relation to the shafts of the tilting device. Fig. 6b shows clearly the faces of the centre part of the tilting device about which the spring of the operating member grips.

Figs. 7c-e are sectional views through the switch which shows the details of the construction thereof for the further understanding of the invention, and where the sections VIIc-VIIc, VIId-VIId and VIIe-VIIe shown in Figs. 7a and 7b refer to respective Figures 7c-7e.

The exterior of the operating element could have a surface mounted thereon which is user friendly with regard to the end product with which the switch device will be used.

The switch should be user-friendly to rotate, and should be designed so that the press and tilt function can be easily executed; see also Fig. 4.

Fig. 8c shows a switch surface 92 mounted directly on the exterior of the operating member or the operating element 80. It will be understood that the operating element 80 may also be made so that the outer face is ready for use and does not need any outer casing. The surface will preferably have a design which provides friction for rotation of the operating element as indicated in Figs. 8a-c.

Fig. 8d has a smooth surface, but can nevertheless provide satisfactory user friendliness. The central position is slightly recessed, i.e., it has a concave shape, with a small projection for reliable function when the centre is pressed.

Fig. 9 shows a variant of the switch shown and described in connection with Figs. 5-7, and which also must be understood in connection with what has been shown and described earlier, in connection with Fig. 1, for example. Fig. 9 shows the different parts used in the construction and the same references numerals as used in Figs. 5-7 are used in this figure. However, here the contact fields 60 and 71-75 and the base plate or base 50 are shown both separately and in an assembled version. The snap discs (plate-shaped springs) 61-65 are mounted separately or are connected to each other as indicated by the reference numeral 94. This solution differs from the solution previously described in that the tilting device 53 is moulded in one piece with the frame 78, as shown in principle in connection with Fig. 1. Shafts 55 and 56 as shown in Fig. 5 have been replaced by flexible suspension arms 96 and 97 attached to the frame. This tilting part 98 (tilting device + frame) has an inlaid contact field 77 which the slip ring 84 will touch. The reference numeral 100 indicates the assembly of the parts where the upper side of the rotatable operating element is adapted for attachment of a user-friendly surface such as that shown in connection with Fig. 8.